

UNITED STATES DEPARTMENT OF AGRICULTURE  
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

STREAM CROSSING

(No.)

Code 728

**DEFINITION**

A trail or travelway constructed across a stream to allow livestock or equipment to cross with minimal disturbance to the stream ecosystem.

**PURPOSE**

To prevent or minimize water degradation from sediment, nutrient, and organic loading. To protect the water course from restricted capacity, degradation, and adverse hydrological impacts. To protect the land from streambank erosion. To provide a means for people, animals, equipment, or vehicles to cross a water course.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to all land uses where an intermittent or perennial water course exists, and a ford or culvert type crossing must be made by livestock, people, and/or equipment.

**CRITERIA**

**General**

**Location.** Stream crossings shall be located in areas where the streambed is stable. Where practical, crossings shall be located just upstream of any natural barrier such as a rock seam or large boulder. Avoid sites where channel grade or alignment changes abruptly, instability is evident, overfalls exist, or large tributaries enter the stream. Wetland areas shall be avoided if at all possible. If impact to wetlands cannot be avoided, follow Natural Resources Conservation Service wetland policy and procedures and Corps of Engineers requirements.

Crossings shall be installed perpendicular to the direction of the flow of the stream.

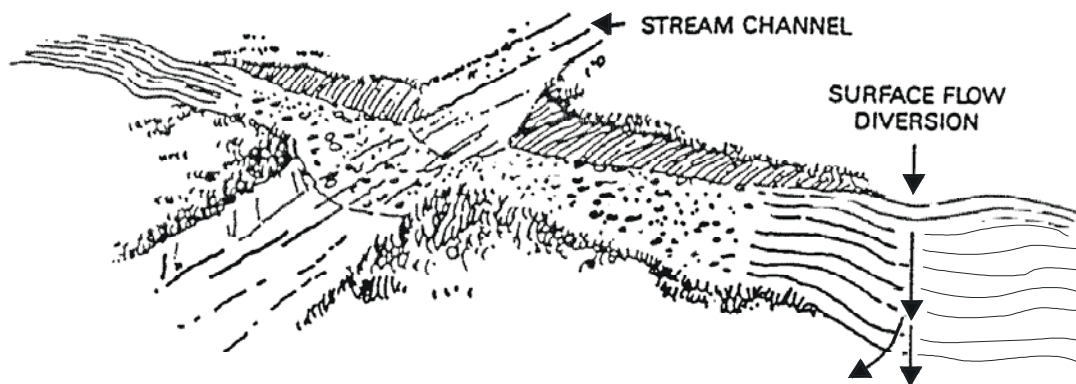
**Width.** Multi-use crossings shall be no less than 10 feet and no more than 20 feet wide in the upstream-downstream direction. "Cattle only" crossings may be as narrow as 6 feet wide. Width is defined as the crossing surface and does not include the side slopes.

**Side Slopes.** All cuts and fills for the stream crossing shall have side slopes that are stable for the soil or soil material involved. Side slopes of earth fills shall be no steeper than 2.5 horizontal (H) to 1 vertical (V). Rock fills shall be no steeper than 1.5 (H) to 1 (V). Cut slopes shall be no steeper than 2.5 (H) to 1 (V) unless in rock or hard shale, in which case they shall be no steeper than 1/2 (H) to 1 (V).

**Entrance and Exit Approaches.** Entrance and exit approaches to the stream crossing shall blend in with existing site conditions where possible, but shall not be steeper than 5 (H) to 1 (V). The entrance and exit approaches shall be underlain with geotextile filter fabric and covered with 8 inches of stone or gravel. The minimum width of the approaches to the structure shall be equal to the width of the structure.

A surface flow diversion shall be installed across the entrance and exit of the travelway to prevent sediment laden runoff from entering the stream. (See Figure 728-1). Roadside ditches shall be designed as needed adjacent to the entrance and exit roads to direct surface flow into the diversion or away from the crossing surface.

NRCS, Alabama  
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**Figure 728-1. Stream Crossing with Diversion**

**Fencing.** Fencing is not necessary at all sites. Stream channel areas above and below the stream crossing shall be permanently fenced if needed to prevent livestock access to the stream except at the crossing. Fence posts along each side of fords shall be installed inside the area covered with geotextile filter cloth and stone. Fence posts with sharpened ends shall be driven through the filter cloth in the center of the toe trenches along the side of the crossing.

A "break-away" fence may be installed across streams where damage from runoff is likely to occur. The fencing wire shall be placed on the downstream side of the posts on each fence line. Strands of wire shall not be continuous across the crossing, but shall be cut and secured lightly to the posts so that a buildup of trash will pull the wire away from the post, allowing the trash to move downstream.

In lieu of "break-away" fences across the stream, other appropriate means of preventing livestock access to the stream, such as swinging gates, electrified chains, or positive control measures may be used.

Fencing shall be built to meet NRCS Conservation Practice Standard 382 - Fence. Fencing except in areas with "break-away" sections.

**Safety.** The specifications contained in this practice pertain primarily to flow capacity and resistance to washout of the structure. From a safety and utility standpoint, the designer must also be sure that the structure is capable of withstanding the expected loads from farm equipment that will be crossing the stream.

A gauging rod may be needed at ford crossings to determine depth of flow and safety of crossing.

**Shade.** Ford crossings with free access by cattle shall have limbs pruned near the ford to minimize shade and thereby reduce cattle loafing time in the stream.

### **Culvert Crossings**

The structure shall be large enough to convey the flow without appreciably altering the stream flow characteristics. The pipe shall be sized to handle the bank full flow or the peak runoff from the 10-year, 24-hour storm whichever is less. The culvert shall be adequately protected so that out-of-bank flows safely bypass without culvert or stream bank damage. (Refer to NRCS Conservation Practice Standard 587 - Structure for Water Control, for other culvert design criteria.)

The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes. The culvert pipe shall be placed on-grade with the existing stream bottom.

Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, and new or used high quality steel. Other materials may be deemed appropriate by the engineer.

Compacted fill will be used to form the crossing. The minimum depth of compacted fill over the culvert shall be equal to one-half the diameter of the culvert, or 24 inches, whichever is greater. The compacted fill shall be built up over the culvert so that any stream overflow will cross the road at a point away from the culvert. (See

Figure 728-2.) The top of the compacted fill shall be covered with 6 inches of AASHTO

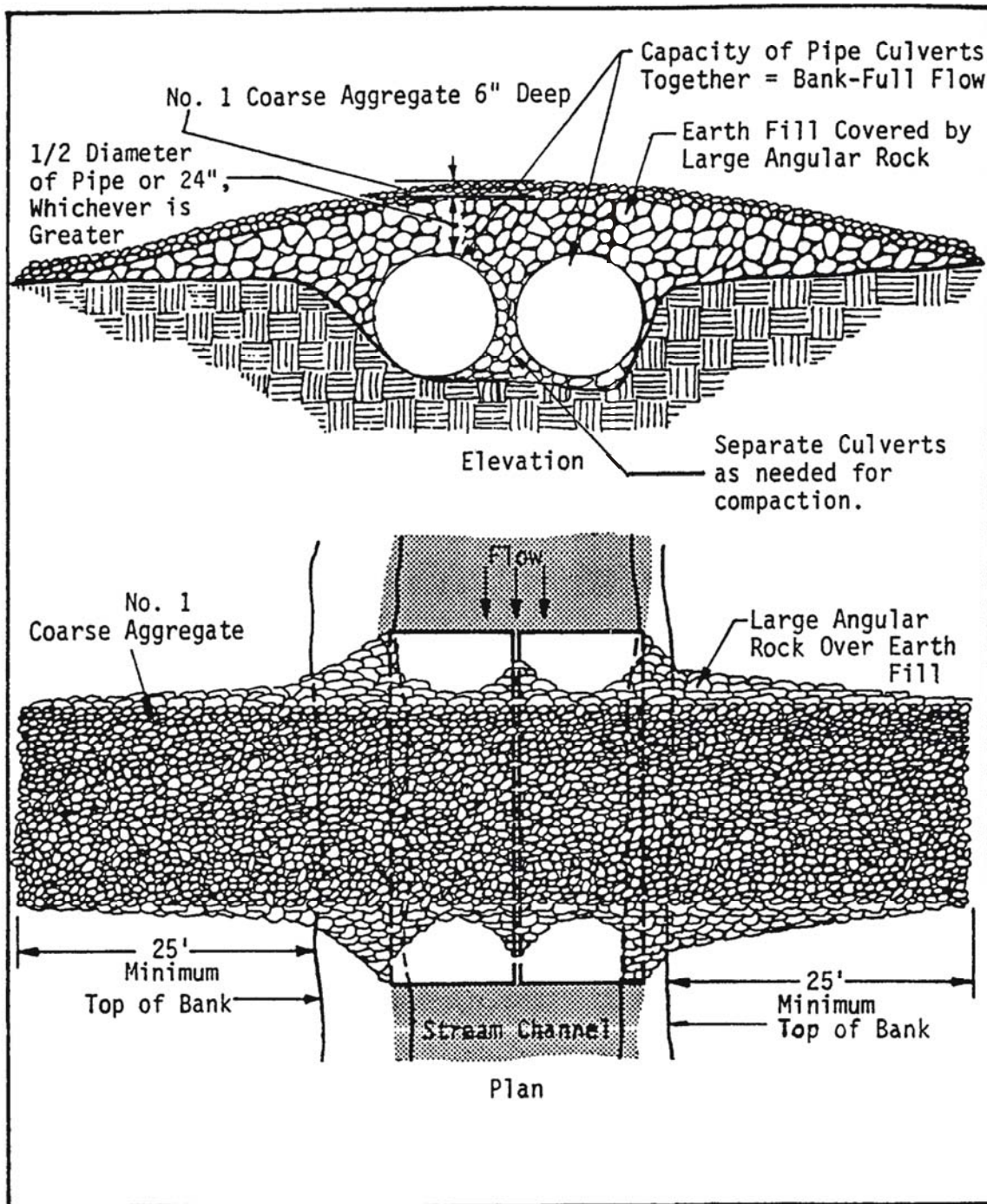


Figure 728-2. Culvert Stream Crossing.

No. 1 stone (3/4 in. to 4 in.). Place geotextile filter fabric beneath the stone as needed.

If protection of the sides of the fill from erosion is needed, riprap shall be used as shown in Figure 728-2. The total thickness of riprap shall be at least 18 inches. A concrete headwall or grouted riprap may be required in severe cases.

### **Fords Using Geotextile and Stone**

Figure 728-3 shows a typical layout for a well constructed ford (fence not shown).

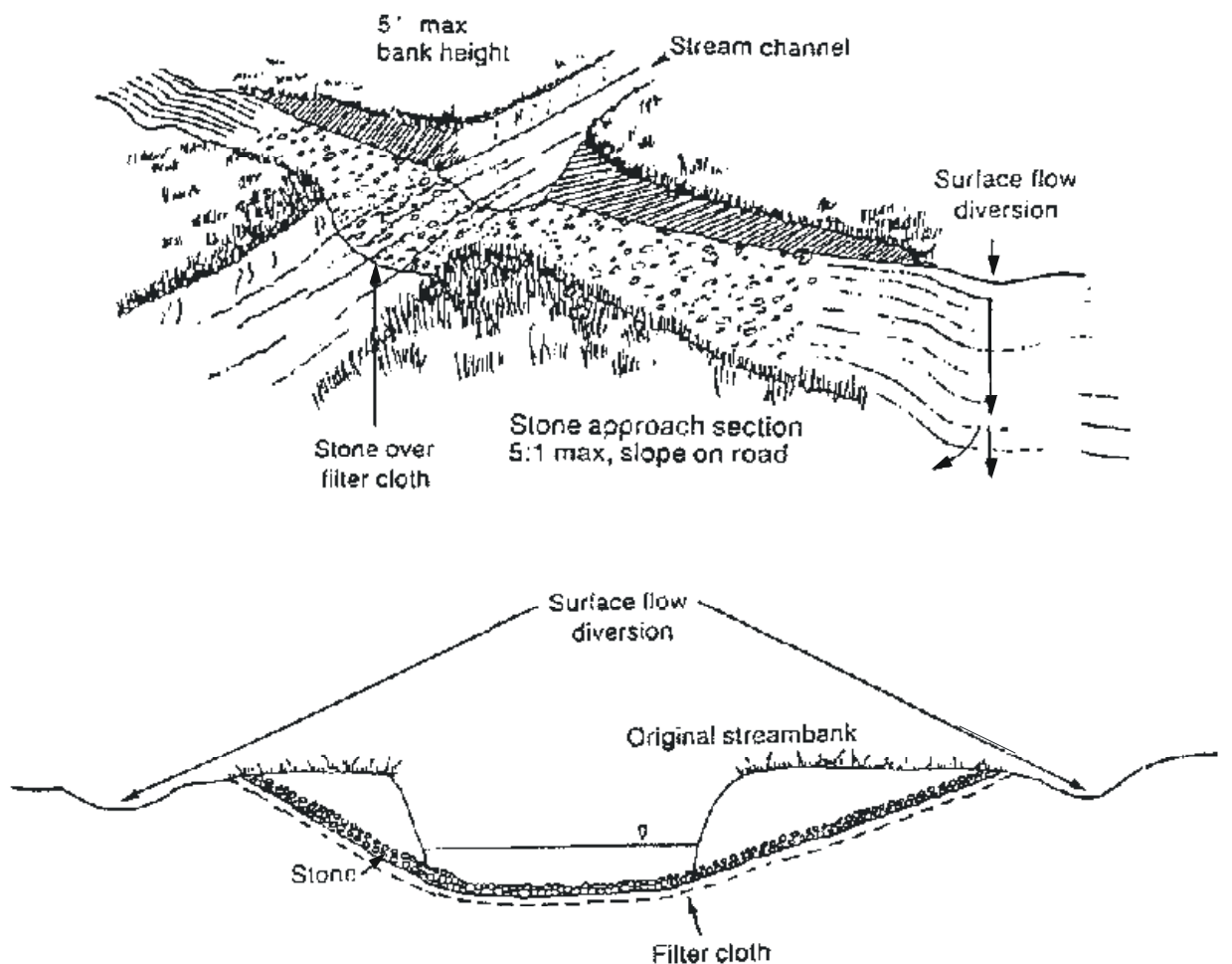
The following criteria shall be added as needed to determine the excavation depth of the stream bed for installation:

Surfacing stone depth: 8 inches (minimum)

Hoof contact zone depth (optional): 4 inches (maximum)

Geotextile filter fabric material shall be installed on the excavated surface of the ford according to the specifications contained in this standard. The fabric shall extend across the bottom of the stream and at least 20 feet up each approach section. Fabric may be omitted in streambeds with stable rock, gravel, or cobbles. All edges of the fabric shall be keyed as described under construction specifications.

The stream crossing must be designed to remain stable during either the bank full event or the peak runoff from a 10-year, 24 hour event, whichever is less. Channel velocities shall be computed or measured, and a stone size chosen from Table 728-1. The surfacing stone shall consist of a layer a minimum of 8 inches thick.



**Figure 728-3. Ford Stream Crossing.**

Table 728-1. Maximum velocity and D<sub>50</sub> sizes

Maximum Velocity	D <sub>50</sub> *
(fps)	(inches)
2.7	0.5
3.2	1.0
4.3	2.0
5.3	3.0
6.3	4.0

\*Diameter of stone such that 50% (by weight) of the stones are smaller.

Rock crossings for livestock use may have a hoof contact zone over the surfacing stone or gravel. This zone could include ground limestone, rock screenings, crusher run, or similar materials. This material does not have to meet any velocity criteria. This layer is expected to be replaced periodically by the landowner as livestock traffic or runoff events erode the surface material.

The final surface of the stone in the bottom of the watercourse shall be no higher than the original stream bottom on both the upstream and downstream edges of the ford in order to eliminate any overfall and possible scour problems.

#### **Fords Using Geotextile, Geocell, and Stone**

The 6 inch tall geocell will be the minimum requirement. The 8 inch tall geocell is recommended. (See Figure 728-4). The geocell material shall not be used if velocities are expected to exceed 5 fps. If the stone overfill were to be scoured, exposing the geocell outline, cattle may not want to cross this structure. In order to minimize velocities, locate the crossing within a stream reach that is not steeply graded.

The following criteria shall be added as needed to determine the excavation depth of the stream bed for installation:

geocell depth: 6-8 inches

overfill: 2 inches (minimum)

hoof contact zone depth (optional): 4 inches (maximum)

Install geotextile and geocell as shown in Figure 728-5. The geotextile and geocell shall extend across the bottom and at least 20 feet up each approach section. Fill geocell with AASHTO No. 2 stone, (3/4 in. to 3 in.) plus, add 2 inches (minimum) of stone above the geocell. Use

staples, clips, anchor pins or earth anchors as required by manufacturer.

Rock crossings for livestock use may have a hoof contact zone over the surfacing stone or gravel. This zone could include ground limestone, rock screenings, crusher run, or similar materials. This material does not have to meet any velocity criteria. This layer is expected to be replaced periodically by the landowner as livestock traffic or runoff events erode the surface material.

The final surface of the stone in the bottom of the watercourse shall be the same elevation as the original watercourse bottom in order to eliminate any overfall and possible scour problems.

### **CONSIDERATIONS**

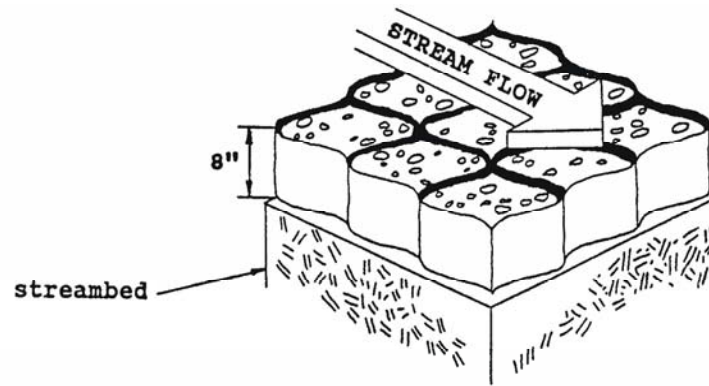
#### **General**

Avoid crossing streams when possible. Stream crossings can be a direct source of water pollution; they may create flooding and safety hazards; and they can be expensive to construct.

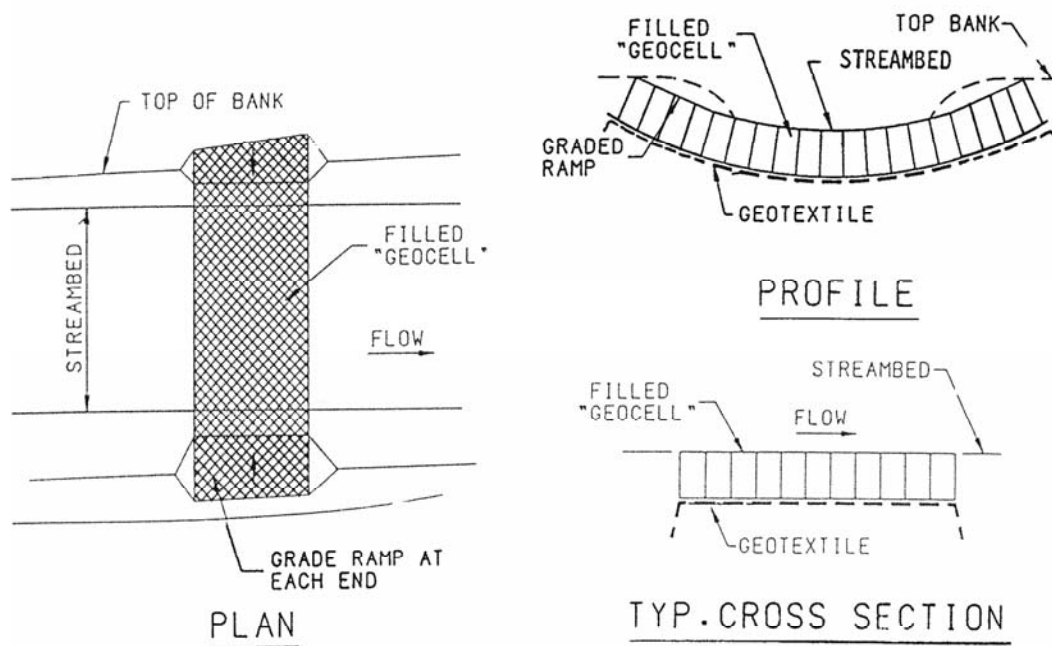
Fords made of stabilizing material such as rock riprap are often used in steep areas subject to flash flooding, where normal flow is shallow or intermittent. Fords have the least detrimental impact on water quality when crossing is infrequent. Fords are especially adapted for crossing wide, shallow watercourses with firm streambeds. Generally, fords should not be used where bank heights exceed 5 feet. Mud and other contaminants are brought into the stream by vehicular and animal traffic where fords are used. Access to fords will be prevented during high flows. Cut slopes of 3 (H) to 1 (V) or flatter are recommended to facilitate vegetation and ease of maintenance. When using geocell in soft stream bottoms with heavy equipment crossing the ford, consider over excavating the stream bottom and installing geotextile and rock as a foundation for the geocell.

For heavily used areas, consider using a culvert instead of a ford. However, culverts are not recommended for large drainage areas. Evaluate each specific site carefully to determine if a ford or culvert is most appropriate. When a culvert is utilized, consider using riprap outlet protection since culverts concentrate flow and often create streambed scour.





**Figure 728-4. Geocell.**  
 (Hydraulic Flow diagram provided with permission from Presto Products, GEOSYSTEMS Division.)



**Figure 728-5. Stream Crossing using Geocell.**

Roads or trails leading to stream crossings will normally slope into the stream. Water diversions should be installed to move sediment laden runoff from the trail or road and to disperse the runoff onto an undisturbed area for filtering. Stream crossings should provide a way for normal passage of water and aquatic animals within the channel.

Consideration should be given to erosion and sedimentation which will be caused by the installation of the crossing and any necessary stream diversion. Construction should be done during the driest part of the year. Stream crossings for normal farming and silviculture activities are exempt from the U.S. Army Corps of Engineers 404 permit requirements as long as construction and maintenance is in accordance with Best Management Practices.

### **Construction Equipment**

Experience has proved that certain types of construction equipment are more suitable for installation of stream crossings than others. Where crossings are on small drains with stable subsoils, equipment choice may not be critical. Where non-plastic silts and clays or unstable fine sands are anticipated in the subgrade material, the following observations should be noted:

- \* Tracked equipment is superior to rubber-tired equipment.
- \* Crawler tractors with angle dozer or bulldozer blades and fixed bucket front end loaders should be avoided.
- \* Smaller, lighter dump trucks to deliver surfacing material will cause less damage to approaches than large trucks.
- \* Track mounted hydraulic excavators with reaches of 25 feet or more provide the best and fastest installation.
- \* A tracked front-end loader with a 4 in 1 clamshell type bucket and a large rubber tired backhoe provide the best installation if a hydraulic excavator is not available.

- \* A gasoline powered pump and hose should be available for pumping excess water from trenches.

Landowners and contractors should be advised of the use of proper equipment. Improper equipment will result in construction difficulties and excessive construction costs.

## **PLANS AND SPECIFICATIONS FOR CONSTRUCTION**

Plans and specifications for stream crossings shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

All disturbed areas, not covered or protected, shall be vegetated as soon as possible. Vegetation shall be established and maintained in accordance with the specifications for NRCS Conservation Practice Standard Critical Area Planting - 342.

## **OPERATION AND MAINTENANCE**

The stream crossing and associated fence should be inspected on a frequent basis, especially after major storm events. Any disturbed materials should be repaired or replaced as soon as possible to prevent further damage from occurring. Surfacing stone used for livestock crossings should be replaced as needed. Break-away type fences will need to be repaired after major runoff events.

During high flows, sediment and deposition will occur on approaches to fords. This berm of soil and debris will need to be occasionally removed.

## **REFERENCES**

NRCS Conservation Practice Standards  
 Fence - Code 382  
 Structure for Water Control - 587  
 Critical Area Planting - 342



**CONSTRUCTION SPECIFICATIONS****STREAM CROSSING****(No.)****CODE 728****SCOPE**

This item shall include all plans, specifications and construction operations required for the installation of stream crossings. Construction operations shall be carried out in such a manner that erosion, air, water, and noise pollution will be minimized within legal limits as established by state regulations.

**SPECIFICATIONS****Clearing and Grubbing**

Clearing and grubbing shall be kept to the minimum needed in order to install the structure. All trees and brush shall be removed from the area before excavation starts. The foundation shall be cleared of all stumps, roots, brush, sod, and other debris. All waste materials shall be disposed of in a sightly and work-man-like manner in a designated area outside the natural floodway. Limbs shall be pruned around ford crossings which have free access by cattle in order to minimize shade in the crossing.

**Foundation Excavation**

All material shall be removed from the foundation of the stream crossing to the depths, widths, and lengths required by the design. Excavation may be limited to one side of the stream at a time in order to facilitate diversion of the stream. It may be advantageous to divert the stream flows around the site using a pipe or ditch. The stream may also be temporarily impounded during construction. Note, however, that stream diversion during construction shall be conducted in a manner that minimizes erosion and sedimentation.

For ford construction, trenches at least 1 ft. wide and 2 ft. deep shall be excavated along the upper ends of entrance and exit approaches and on both the upstream and downstream sides of the stream crossing.

**Diversions**

Diversions and side ditches shall conform to the lines, grades, and sections as specified on the plans.

**Geotextile Filter Cloth (for Fords)**

Geotextile filter cloth shall be a non-woven needle-punched geotextile material with a minimum tensile strength of 120 lbs. (minimum average roll value).

A geotextile filter cloth shall be installed under the entire crossing as well as in the toe trenches.

Longitudinal ends of the geotextile filter cloth shall be lapped back over the top of the backfill toe trench a minimum of one foot beyond the edge of the trench and anchored to the fabric using anchoring pins placed on five foot centers. When more than one width of cloth is required, the downstream panel shall be installed first. The next upstream panel shall be installed with a minimum of 18 inches overlap over the first section. Anchoring pins shall be installed on 3 foot centers, 6 inches from the downstream edge of the lap. Pins shall penetrate both sections of cloth in the lap.

Every precaution shall be taken not to tear the geotextile filter cloth. Tears shall be repaired immediately by removing all surface material and soil from the tear for a minimum distance of 18 inches in all directions of the tear. Spread a new section of cloth over the cleared area and anchor with anchoring pins around all sides.

Where stream channels are composed of a stable coarse rocky material or solid bedrock, the requirement to extend fabric filter cloth across the channel bottom may be waived upon the approval of the engineer.

### **Anchoring Pins for Geotextile**

Anchoring pins shall be fabricated using No. 3 reinforcing steel or material of equivalent or greater size and durability and shaped as shown on the drawings. All anchor pins shall be installed with the top width lying perpendicular to the direction of flow in the stream. Pins shall be driven vertically into undisturbed soil to provide maximum resistance to removal.

Anchoring pins shall be placed through the filter cloth at all excavated trenches on approximately 3 foot centers. Pins shall be installed through all overlapped fabric and across the width of the channel bottom on approximately 3 foot centers. For crossings using only one width of fabric, plan to use a number of pins equal to 0.85 times the total length of the crossing from entrance to exit end. For crossings using two widths of fabric, use 1.3 times the total length.

Care shall be taken not to rip the fabric while installing anchor pins. Pins shall be sharpened to permit easy penetration through the fabric. Also, the fabric will fit tightly around anchor pins with sharpened ends. If a pin must be removed, plug the opening with a wadded ball of fabric filter cloth.

Light weight wire staples such as used to anchor mulch netting may be used to hold filter cloth in place temporarily while construction is in progress. Such staples cannot substitute for anchor pins.

### **Culvert pipes**

Pipes shall be on a firm foundation to the neat lines and grades shown on the plans. Selected backfill shall be placed around the pipes in

4-inch layers and thoroughly compacted. Gravel can be used to bed pipe under wet conditions and the gravel shall be protected with larger stone at the upper and lower ends of the pipe.

Joints of pipe will be sealed in accordance with the manufactures' specifications. Pipes will not be laid directly on rock; there must be a soil bed or gravel cushion of at least 6 inches between the pipe and rock.

The outlet end of culverts shall terminate on the natural streambed unless protective outlet structures are installed.

Culvert materials shall be as specified by the engineer or as shown on the drawings.

### **Stone Aggregate**

Acceptable material consisting of coarse sands and/or gravel, if present in the foundation excavation, may be stockpiled for later use in the toe trenches or on the roadway. Large washed stone or creek gravel may be used to prepare a foundation for the geotextile filter cloth in unstable soils. Coarse stone may also be used as a subgrade filler between the filter cloth and the surfacing material.

No equipment shall operate directly on the geotextile until surfacing material is spread with a minimum of 6 inches of cover over the geotextile.

### **Inspection**

All materials shall be inspected by the technician before installation. Written certification of conformance to specifications will be required if physical inspection is not conclusive.